

Risk Evaluation

APHIS Evaluation of the Classical Swine Fever Status of Sinaloa, Mexico

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Introduction

In 1997, APHIS staff conducted a site visit to Sinaloa, Mexico to evaluate the status of the government's national program to eradicate Classical Swine Fever [1].

In assessing the Classical Swine Fever (CSF) status of Sinaloa, and in accordance with its regulations [2], APHIS evaluated the following factors based on the site visits, and additional information provided by the government of Mexico:

- Authority, organization and infrastructure of veterinary services;
- Disease surveillance;
- Diagnostic laboratory capabilities;
- Disease outbreak history and disease prevalence;
- Active disease control programs, if any, if the agent is known to exist in the region;
- Vaccination status;
- Disease prevalence and outbreak history in adjacent regions;
- Separation of the region from regions of higher risks through physical or other barriers;
- Control of movement of animals and animal products from the regions of higher risk;
- Livestock demographics and marketing practices; and
- Animal health policies and infrastructure for animal disease control.

A summary of the data relating to each of these factors is provided below.

Description of the disease [3, 4]

Classical Swine Fever, previously known as "Hog Cholera" is a highly contagious disease of swine caused by a virus of the togaviridae family. The incubation period is usually 3-4 days, but may range from 2-14 days. In the typical acute form, pigs present with anorexia, fever of 41degrees C or more, muscle tremors, prostration, mucopurulent ocular discharge, and multiple superficial and internal hemorrhages, resulting in a purplish discoloration of the skin. Morbidity and mortality are high. In the final stages, nervous system involvement is manifested through nervous signs, paralysis, and death, usually in 10-15 days. A chronic form exists with milder symptoms, in which mature animals occasionally recover. Chronic CSF is characterized by prolonged and

intermittent anorexia, fever, alternating diarrhea and constipation, and alopecia. The atypical form, associated with low virulence virus strains, may present as Congenital Tremor, characterized by tremors in the head, neck, dorsal area, and hindquarters. Transplacental infection with low virulence strains may result in persistently infected piglets, which are a major cause of virus dissemination to uninfected farms.

The pig is the only natural reservoir of CSF. Blood, tissues, secretions, and excretions from an infected animal contain the virus. Transmission occurs mainly through the oral route, although infection can occur through the conjunctiva, mucous membrane, skin abrasions, and inseminations. Feeding of raw or insufficiently cooked garbage containing infective pork material is a potent source of CSF virus.

Regional Risk Factor Information

Authority, organization and infrastructure of regional veterinary services [1, 5]

A decree published in the Federal Official Daily of March 25, 1980 in Mexico established the National Campaign for the control and eradication of CSF. The campaign is mandatory and permanent throughout the entire country. The Ministry of Agriculture and Water Resources (SARH) has offices in Sinaloa. The office includes the livestock sub-delegation, which covers the functions of animal health, livestock development and grazing. Under these are the campaigns units, registration and zoo sanitary service units, Federal Inspection Standard (TIF) plant inspectors, livestock development unit; livestock promotion unit and livestock development center. Sinaloa is divided into six Rural Development Districts (DDR) with technical staff coordinated by the livestock sub-delegation. A collaborative relationship exists between the pork producers association, the Federal Livestock sub-delegate Office, and the State Animal Health official from the central offices. Hog slaughtering and processing is done in TIF establishments in compliance with international sanitary requirements and have veterinary sanitary officers and certification by the countries to which they export.

An APHIS site visit conducted in February, 1997 determined that the cooperative relationships between the Federal and State governments and industry are excellent, and that the veterinary infrastructure is efficient and reliable.

Type and extent of disease surveillance [5, 6]

Sinaloa began CSF eradication in 1991. During eradication, positive CSF serology was detected, leading to the discovery that one producer had continued vaccination illegally. That case was referred for prosecution. Surveys conducted six months later on younger animals detected no positive samples, thus suggesting vaccination as the most likely explanation for the earlier positive samples.

Mexico is currently eradicating pseudorabies. Blood samples collected for the pseudorabies campaign are also tested for CSF, thus providing additional surveillance. In regions, states or areas under eradication or free of CSF, the federal and state government shares responsibility with swine producers and accredited veterinarians for maintaining epidemiological surveillance for CSF. Surveillance includes inspection of

swine products and byproducts and of the official documentation required for the control of movement from eradication areas into free areas as well as virological monitoring by government and producers. Serosurveys are conducted annually on backyard and commercial operations, but not in the slaughterhouses. Surveillance also includes reporting of all suspected clinical cases from community abattoirs, the TIF, and commercial and backyard farms. In the TIF abattoirs, animal tracebacks are done whenever necessary. Each abattoir has an official veterinarian for ante and post mortem inspection. If an abnormality is detected during inspection, the lot to which the animal belongs is determined and the farm of origin identified.

In 1997, Mexico implemented systematic on-farm surveillance of backyard herds as well as commercial herds in all free states. Mexico adjusted the surveillance as suggested by APHIS in 1996. All commercial herds are monitored on an annual basis [3]. Sinaloa animal health officials prefer more intensive surveillance than in some other states. Fifty-nine pigs are sampled from each separately managed commercial unit. Generally, in start-to-finish operations, 80 % of the samples are from sows, 10 % from boars, and 10 % from feeders over four months of age. For backyard operations, designated sites are selected randomly by an assigned veterinarian. From 1997-1999, Sinaloa sampled 298 backyard premises, with a total of 1,490 backyard pigs. All surveillance costs on commercial farms are borne by the producer. CSF surveillance data for Sinaloa was analyzed to determine the most likely true prevalence of disease over the multiple years of testing data. For commercial herds, with the smaller number of total herds and animals tested, a hypergeometric probability function was used. For the more numerous backyard herds, with larger total numbers of animals tested and smaller numbers per herd, a binomial probability function was used. (See attachment 1 for details of this analysis). In both commercial and backyard herds, the most likely estimated prevalence is 0 for every year. In commercial swine, the probability that CSF prevalence could be as high as 1% (1 infection per 100 animals) and still escape detection on annual surveillance, is vanishingly small at 6.28×10^{-12} . For backyard herds, the numbers are even more convincing. Analysis indicates that the probability of detecting no positive animals on annual surveys if the true prevalence was .1% (i.e., the probability of missing a truly positive animal) is 9.64×10^{-3} . Therefore, if CSF was present at very low levels, or was recently introduced into backyard herds, the likelihood of detecting infection on annual surveillance is very high. This analysis should not be interpreted as a higher probability of disease in commercial herds. Rather, it indicates more power to detect the presence of disease at low levels in backyard herds, due to the large numbers of samples from backyard herds when compared to commercial herds. Since the risk of disease is higher in backyard herds, surveillance that emphasizes the ability to detect disease at low levels in backyard herds is appropriate.

Diagnostic Lab Capabilities [5]

Samples from suspected CSF cases are sent to the National Health Diagnostic Center, located in State of Mexico. Mexico has 8 regional laboratories approved to conduct the immunoperoxidase test and ELISA test for CSF. All test positive samples are sent to the central laboratories in Mexico City for confirmation and tissues of any suspect to the CPA (EADA) laboratory in Mexico City for virus isolation. Both CENASA and CPA use the same tests and test protocols.

Disease outbreak history and disease prevalence [5]

The last outbreak of CSF occurred in 1990, with vaccination prohibited the same year. Mexico declared Sinaloa free of CSF in 1993.

Disease Control Program

CSF is considered an exotic disease in Sinaloa. Therefore, while there are no active disease control programs, the state does maintain both active and passive disease surveillance, as well as ongoing animal movement controls, and an emergency response system to respond if CSF were again detected in the state of Sinaloa.

Vaccination status [5]

Sinaloa discontinued CSF vaccination in 1990.

Disease status of adjacent regions [5]

Sinaloa is adjacent to Sonora, Chihuahua, Durango, and Nayarit. All are declared free of CSF by the government of Mexico. The most recent outbreak in an adjacent state was Durango in 1998. Two pigs were found infected. The outbreak was eliminated by slaughter of all pigs in affected communities, and the state was subsequently declared free.

Degree of separation from areas of higher risk [5]

Sinaloa is bordered on the east by the Sierra Madre Occidental Mountains, which separate the state from neighboring Durango to the southeast. The mountains also allow a limited number of access points. Sinaloa is bordered on the west by the Pacific Ocean and Sea of Cortes. Nayarit is to the south, and Sonora and Chihuahua are to the north.

Control of Animal Movement from High Risk Areas [5]

The primary means for preventing reintroduction of CSF into Sinaloa is through regulations controlling the movement of land, air, and maritime traffic. Movement of live hogs from control zones into free zones is not allowed, thus avoiding the greatest source of risk. Products and byproducts from eradication zones and control zones are not allowed to move to free zones unless they originate in TIF facilities with a current registration and which are authorized by the General Division of Animal Health to market their products and byproducts into CSF free zones. Products must be moved in vehicles sealed with metal straps [3].

Most flights arrive at the airports in Mazatlan, Culiacan and Los Mochis. Passenger baggage is examined and because most domestic flights originate from areas not yet declared free of CSF, food served on airplanes must not contain pork.

Federal regulations exist to control inter and intrastate animal movement. Vehicles

without proper documentation are returned and prohibited products are confiscated and destroyed. Inspection stations are linked by a network of radio communications. Inspection Stations disinfect vehicles entering the state and incinerate confiscated products.

Pork products from states of lower health status than that of Sinaloa may be imported only if they meet time and temperature processing requirements (68 degrees C for 30 minutes or 80 degrees C for three minutes) and if they originate from an approved TIF plant. Live hogs may be imported only from free states and countries. Sinaloa has three interstate and three intrastate checkpoints to control overland movement.

Livestock demographics and marketing patterns [5, 6]

Sinaloa had 461,937 hogs in 1993. Of these, 233,133 were backyard animals intended for consumption on the premise of origin. The 1999 state swine census lists 284,614 hogs on over 33,500 premises. Sinaloa had 92,070 hogs on 25 commercial farms. Pork production in 1993 was 13,988 tons. Swine account for 10% of the total gross value of livestock production in the state and 3.5 % of Mexico's swine production. Sinaloa is a net exporter of pork. The swine industry is concentrated in the northern and central areas of the state. Nine of the state's 18 municipalities have commercial production. Sinaloa has no major livestock markets.

Policies and infrastructure for animal disease control [3]

CSF is not currently known to exist in Sinaloa. Were the disease to be introduced, Sinaloa would implement a stamping-out policy.

Conclusions

- 1) CSF has not been diagnosed in Sinaloa since 1990, despite extensive and ongoing surveillance.
- 2) No vaccination has occurred in Sinaloa since 1993.
- 3) Sinaloa has effective controls on animal movements from areas of higher risk to prevent the reintroduction of CSF.
- 4) Sinaloa maintains a surveillance system capable of rapidly detecting CSF if it were reintroduced.
- 5) Sinaloa has the laws, policies, and infrastructure in place to detect, respond to, and eliminate any occurrence of CSF.
- 6) Given the virulent nature of the disease in this naive population, and the proven ability to detect disease if it were re-introduced, the ongoing surveillance indicates that the likelihood of CSF virus being present in the commercial swine operations of Sinaloa is low.

References

- 1) APHIS Site Visit Report Review of the States of Sinaloa and Chihuahua for consideration of Hog Cholera (CSF)-Low Risk Status and Background Information for the Future Review of Exotic Newcastle Disease (END) Status in Sinaloa, February 1997.
- 2) Regionalization Final Rule; Importation of Animals and Animal Products. 62 FR 56000-56026.
- 3) Ministry of Agriculture and Rural Development; Official Mexican Standard NOM-ZOO-1995, National Classical Swine Fever Campaign
- 4) Hog Cholera. In Foreign Animal Diseases, United States Animal Health Association, p. 273-282, 1998.
- 5) Report of Characterization of the State of Sinaloa for International Recognition as a Classical Swine Fever Free Zone, Subsecretaria de Ganaderia, Direccion General de Salud Animal; June, 1994.
- 6) Additional Information Requested for the Recognition of the States of Baja California, Baja California Sur, Sinaloa, and Chihuahua as Low Risk for Classical Swine Fever, 1999.

Appendix 1

Data Analysis of Commercial and Backyard Herds based on Annual Surveillance Data for CSF in the State of Sinaloa

Sinaloa Surveillance Information

CSF in Sinaloa		Year	1997	1998	1999	2000
	Total Population			91871	97070	
	Number of Herds			26	25	
	sample size		59	59	59	
	Total Samples (Commercial)		1523	1388	1534	
	Presumed Prevalence=5%					
	Total Population (Back Yard)			284614	284614	
	Number of Herds (Back			33536	33536	
	sample size		5	5	5	
	Total Samples(Back Yard)		1495	1527	1617	
	Presumed Prevalence=1%					
	Grand Total Samples		3018	2915	3151	0
Immunoperoxidase Test		Sensitivity	0.97			
		Specificity	0.97			

Hypergeometric Probability Function of Commercial Herds

Prevalence (P)	1997 ^a	1998	1999	Total Prob ^b	1-Tot Prob ^c
0.10%	.495	.497	.482	1.14×10^{-1}	9.86×10^{-1}
1.00%	2.38×10^{-4}	1.62×10^{-4}	1.63×10^{-4}	6.28×10^{-12}	1.00
2.00%	1.78×10^{-9}	5.39×10^{-10}	5.38×10^{-10}	5.16×10^{-28}	1.00
5.00%	1.0×10^{-45}	1.0×10^{-45}	1.0×10^{-45}	1.0×10^{-135}	1.00
(n/N) ^d		1.46%	1.67%		

a: Probability of observing zero positive animals in that one survey year if the actual prevalence of CSF was P in the total population.

b: Probability of observing zero positive animals through all years of surveillance, given that there was an ongoing infection in the population of prevalence P.

c: Probability of observing 1 or more positive animals through all years of surveillance, given that there was an ongoing infection in the population of prevalence P; i.e., a measure of survey confidence.

d: Number of samples collected / total population in all commercial herds for that year.

Binomial Approximation to the Hypergeometric Probability Function of Backyard Herds

Prevalence (P)	1997	1998	1999	Total Prob ^a	1-Tot Prob ^b
0.10%	2.24×10^{-1}	2.17×10^{-1}	1.98×10^{-1}	9.64×10^{-3}	9.90×10^{-1}
1.00%	2.98×10^{-7}	2.16×10^{-7}	8.75×10^{-8}	5.65×10^{-21}	1.00
2.00%	7.64×10^{-14}	4.00×10^{-14}	6.49×10^{-15}	1.99×10^{-41}	1.00
5.00%	4.97×10^{-34}	9.64×10^{-35}	9.53×10^{-37}	4.57×10^{-104}	1.00
(n/N) ^c	.53%	.54%	.57%		

a: Probability of detecting zero positive animals through all years of annual surveillance given that the true prevalence was P

b: Probability of detecting 1 or more positive animals in all years of surveillance given

that the true prevalence was P .

c: sample size (n) / total population in backyard herds (N) to give percent of population tested each year during annual surveillance.